Information on the Dewey-Burdock In-Situ Recovery Uranium Site, located in the Southern Black Hills near Edgemont, South Dakota

permit applicant

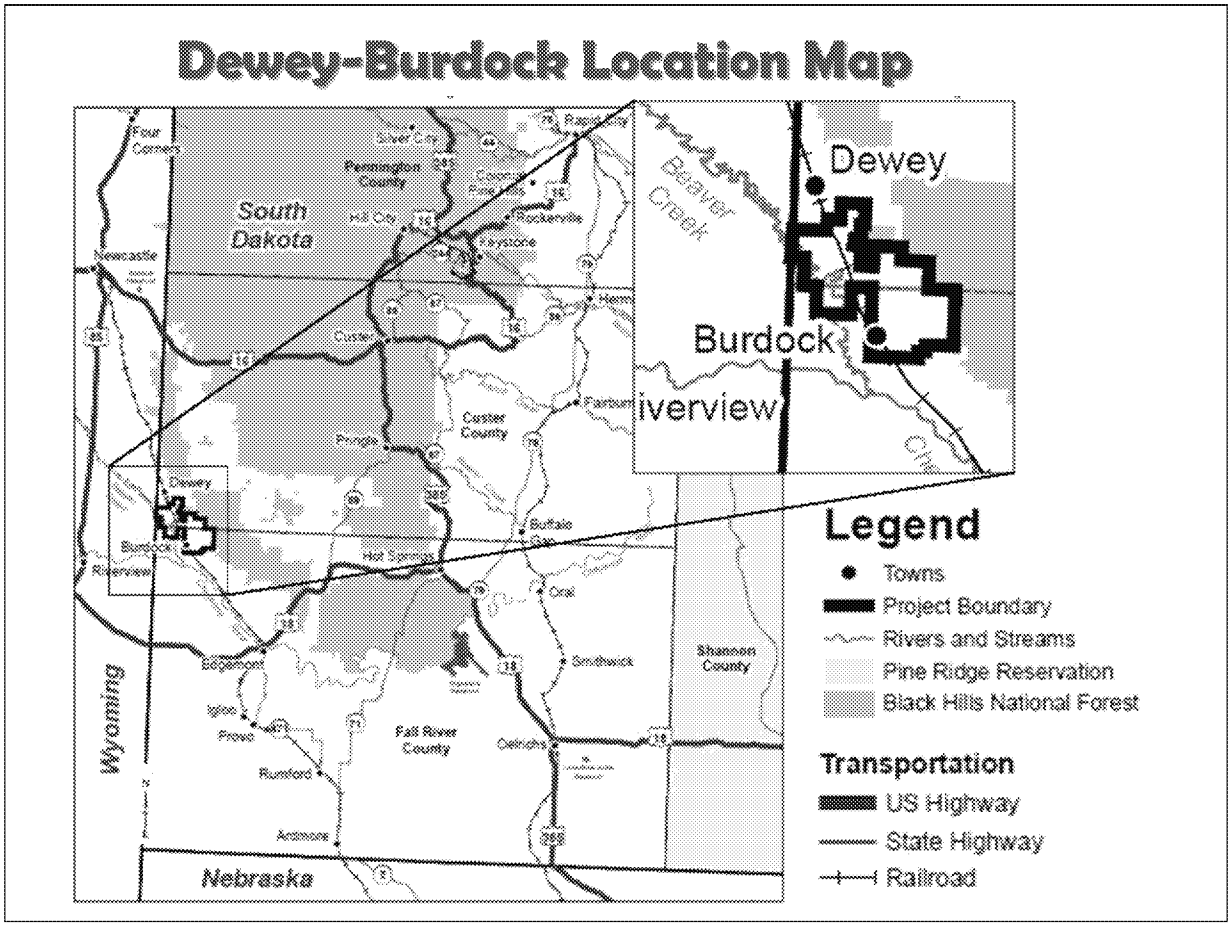
Azarga URANIUM

doing business as

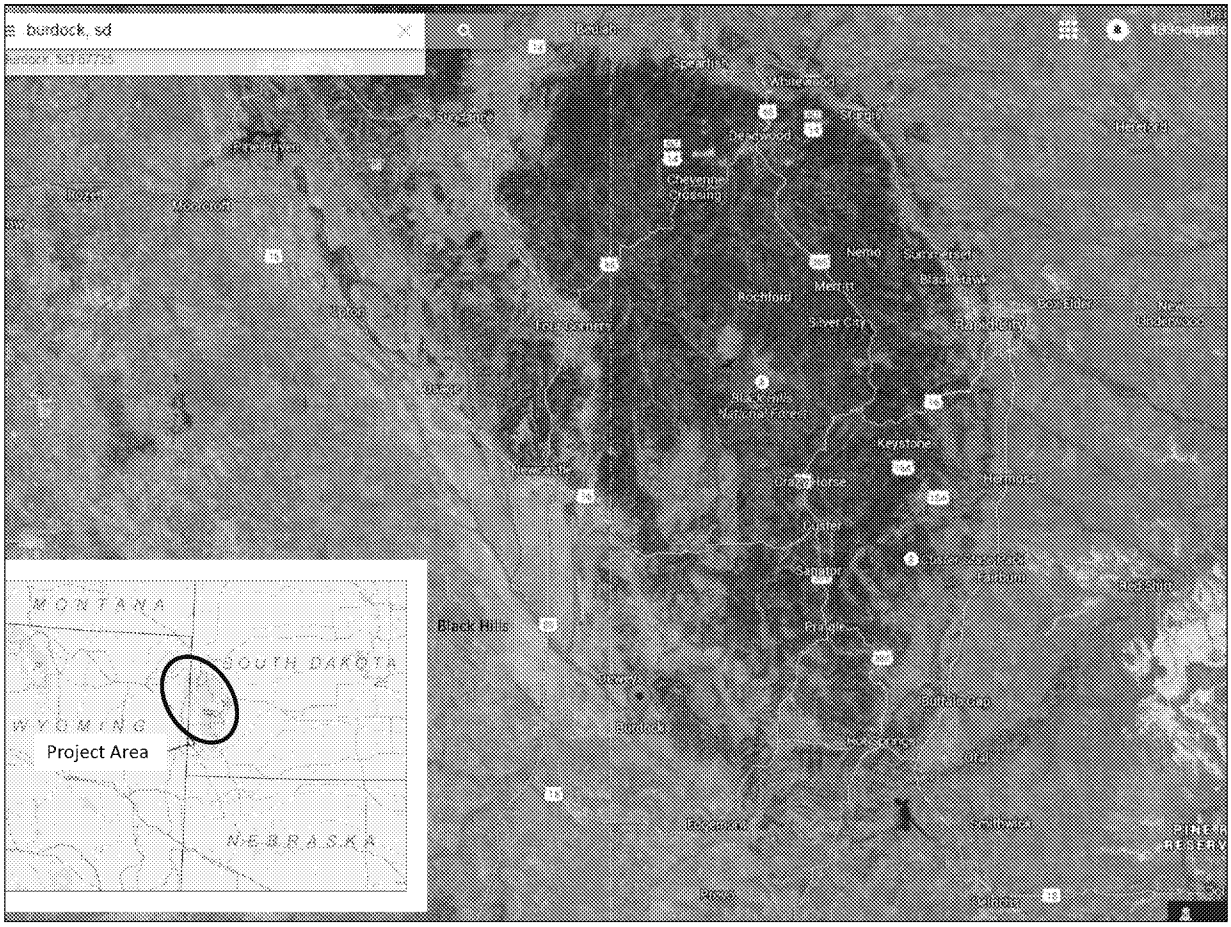
Powertech (USA) Inc.

The EPA Region 8 UIC Program Has Received Permit Applications for Two Types of Injection Wells:

1. A Class III Permit Application for the injection of lixiviant to mobilize uranium in the ore bodies.
2. A Class V Permit Application for the disposal of treated ISR waste fluids into deep wells.



The Dewey Burdock site is located in the SW corner of Custer County and the NW corner of Fall River County on the Wyoming/South Dakota border. In the southern Black Hills. About 45 miles west of the Pine Ridge Reservation. Very close to Cheyenne River which is a concern for Oglala Sioux and Cheyenne River Sioux Tribes since the Cheyenne River borders their reservations.


burdock, sd
MONTANA
SOUTH DAKOTA
WYOMING
NEBRASKA
Project Area
Black Hills

Other Regulatory Agencies at the Dewey-Burdock Site

- The Nuclear Regulatory Commission issued a License for the entire site.
- The South Dakota Department of Environment and Natural Resources has proposed issuance of a Large Mine Permit for the entire site.
- The BLM approved a Plan of Operations for portions of the site on BLM land.
- The South Dakota Department of Environment and Natural Resources has proposed issuance of a groundwater discharge permit for the land application of treated ISR waste fluids.

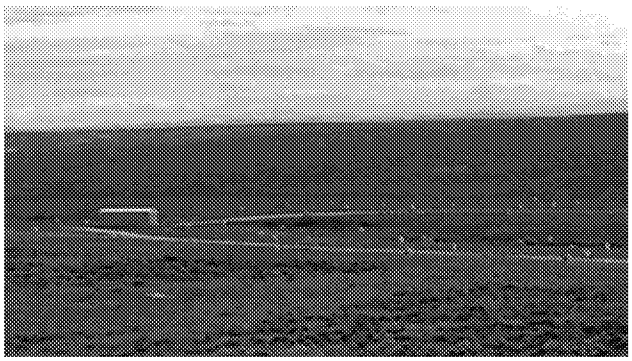
Regulatory Authority of the Underground Injection Control Program at the Dewey Burdock Site

The UIC Program is authorized under the Safe Drinking Water Act to protect *Underground Sources of Drinking Water* from contamination resulting from injection activities.

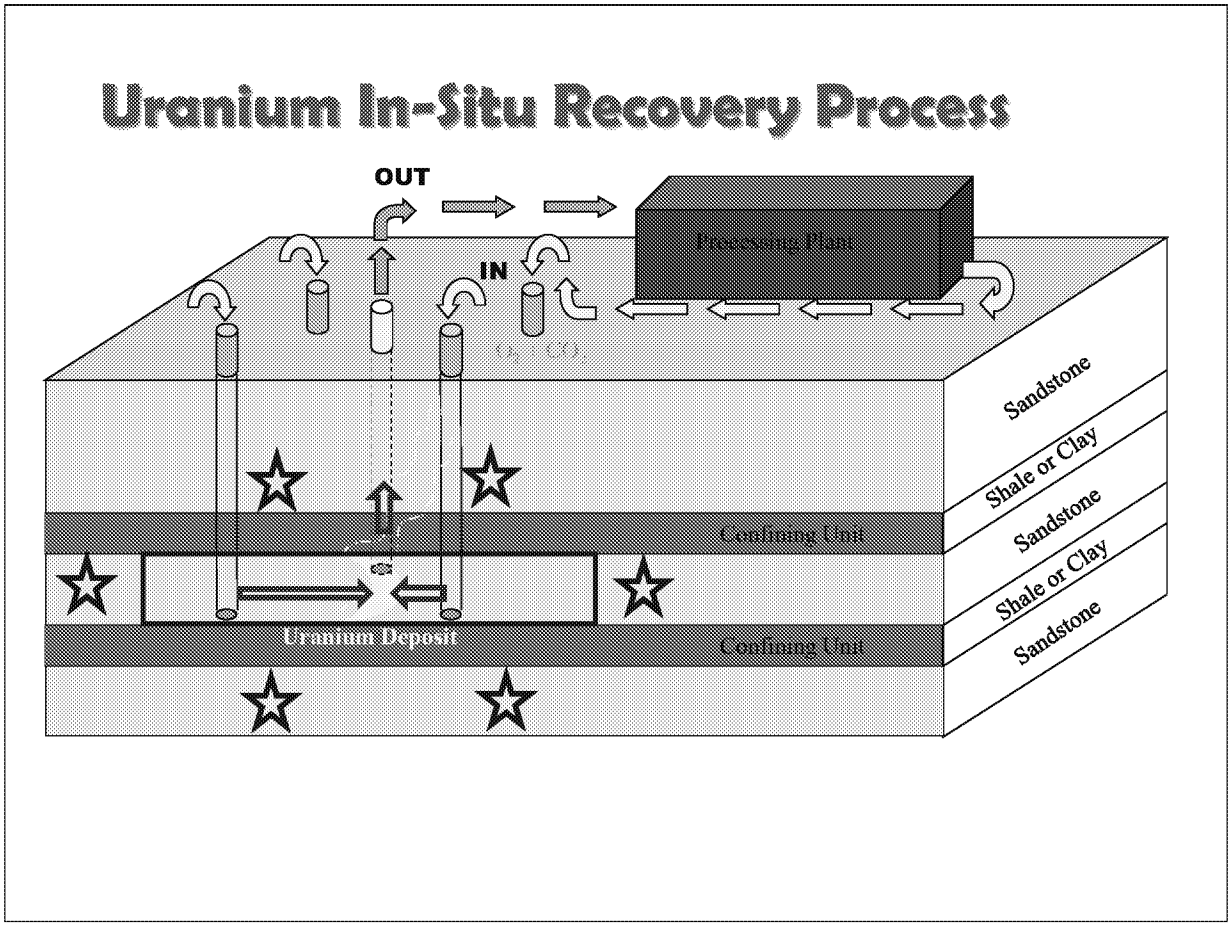
Underground source of drinking water (USDW) means an aquifer or part of an aquifer which supplies drinking water or contains fewer than 10,000 mg/l total dissolved solids.

Dewey-Burdock Uranium In-Situ Recovery Site

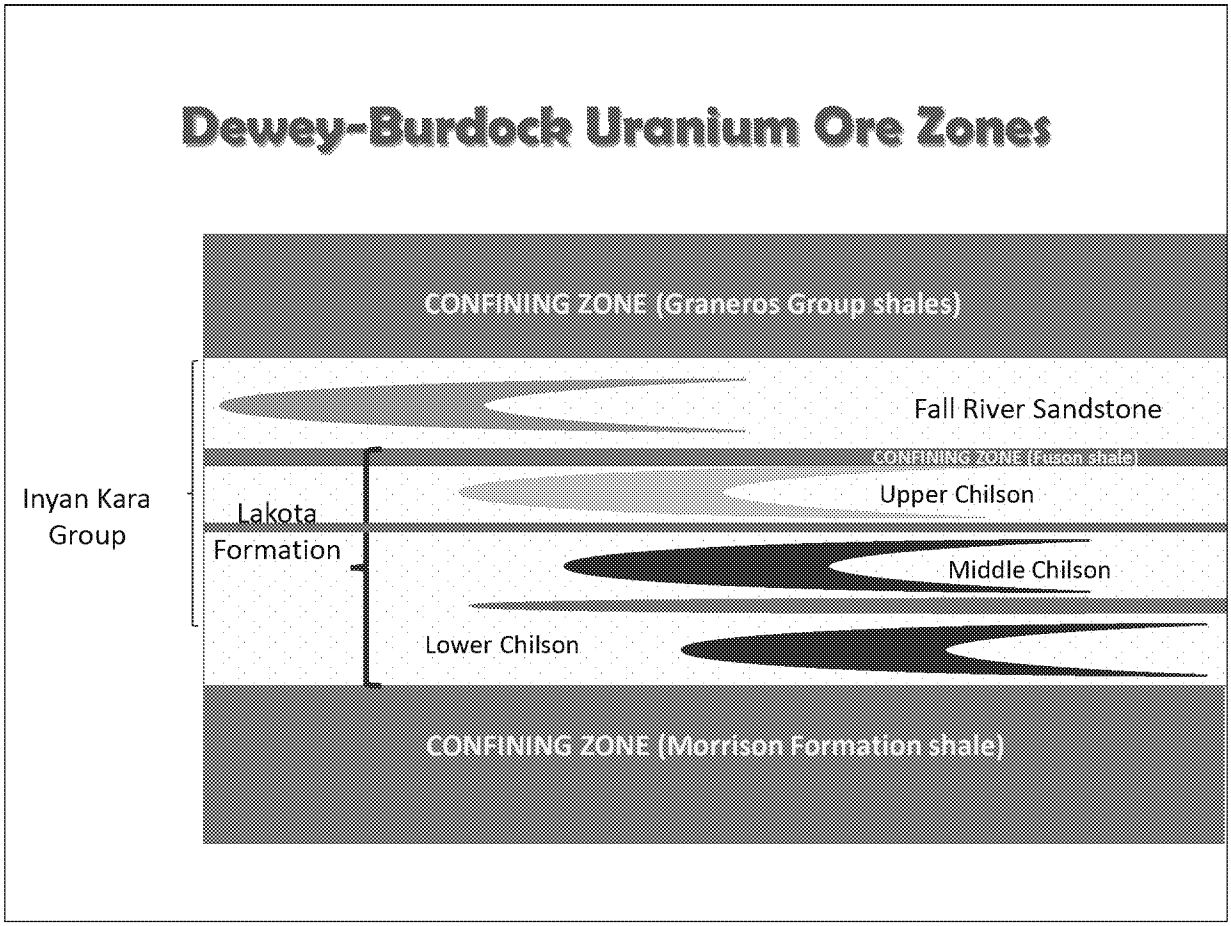
- The Dewey-Burdock site will recover uranium using injection wells.
- There will be no open pits, underground mine workings or tailings piles.
- The uranium will be extracted from the ore deposit using an injected lixiviant.
- The uranium-bearing solution will be pumped to the surface using extraction wells.



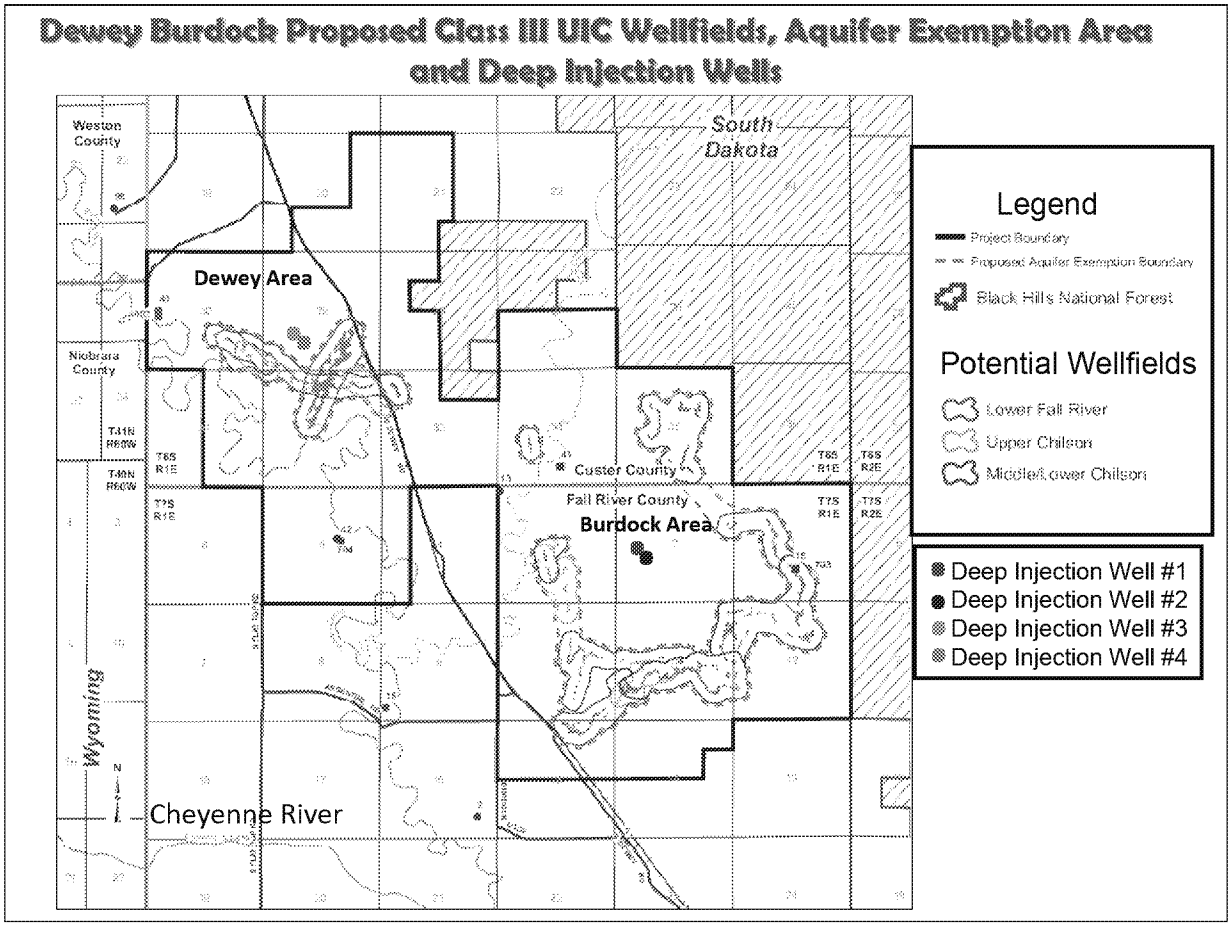
Example of an In-Situ Uranium Recovery Site in WY



Typical five-spot pattern. In three dimensions, the wells follow the uranium deposit. Could be at different depths.
Blue box represents aquifer exemption boundary – this boundary outlines an aquifer that currently does not meet U.S. drinking water standards.
Goal with restoration process after mining is to get this zone back to baseline water quality.
Stars represent monitoring wells where we do not want to see any change in water quality.



The colors of the ore zone on the next map correspond to where the ore bodies are located within the Inyan Kara aquifers. The Fuson Shale is a confining zone between the Fall River Sandstone and the Chilson Sandstone.



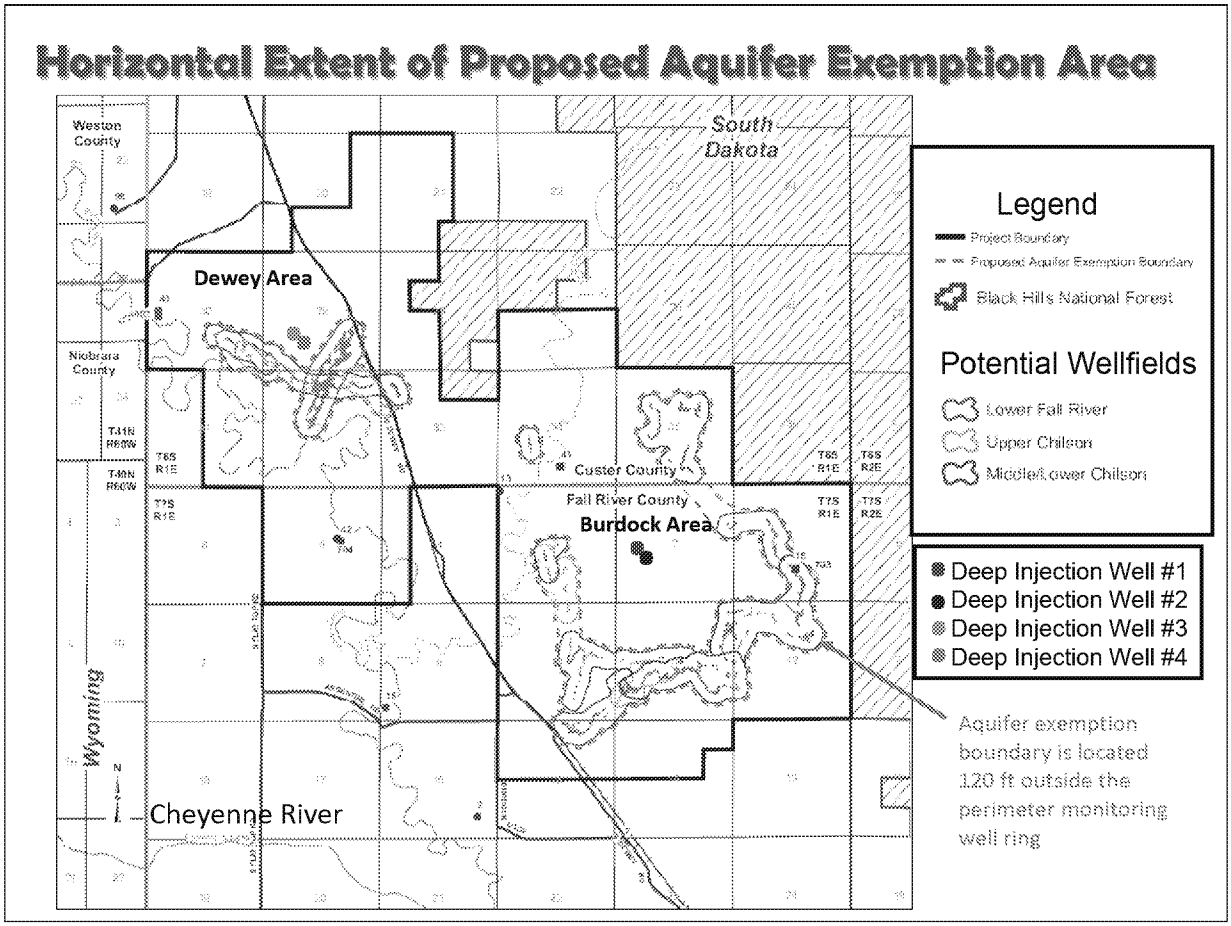
Point out
SD WY Border
Custer and Fall River Counties
Dewey Area & Burdock Area
4 proposed wellfields in Dewey Area & 10 proposed wellfields in the Burdock Area.

The EPA has been requested to Review an Aquifer Exemption

An Aquifer Exemption is required to inject into the Class III wells for uranium recovery.

An Aquifer Exemption is allowed under UIC regulations IF the USDW

1. Does not currently serve as a source of drinking water and
2. Is mineral producing or can be demonstrated to contain commercially producible minerals.



AE Boundary 120 feet outside of wellfield monitoring ring.
Point out:
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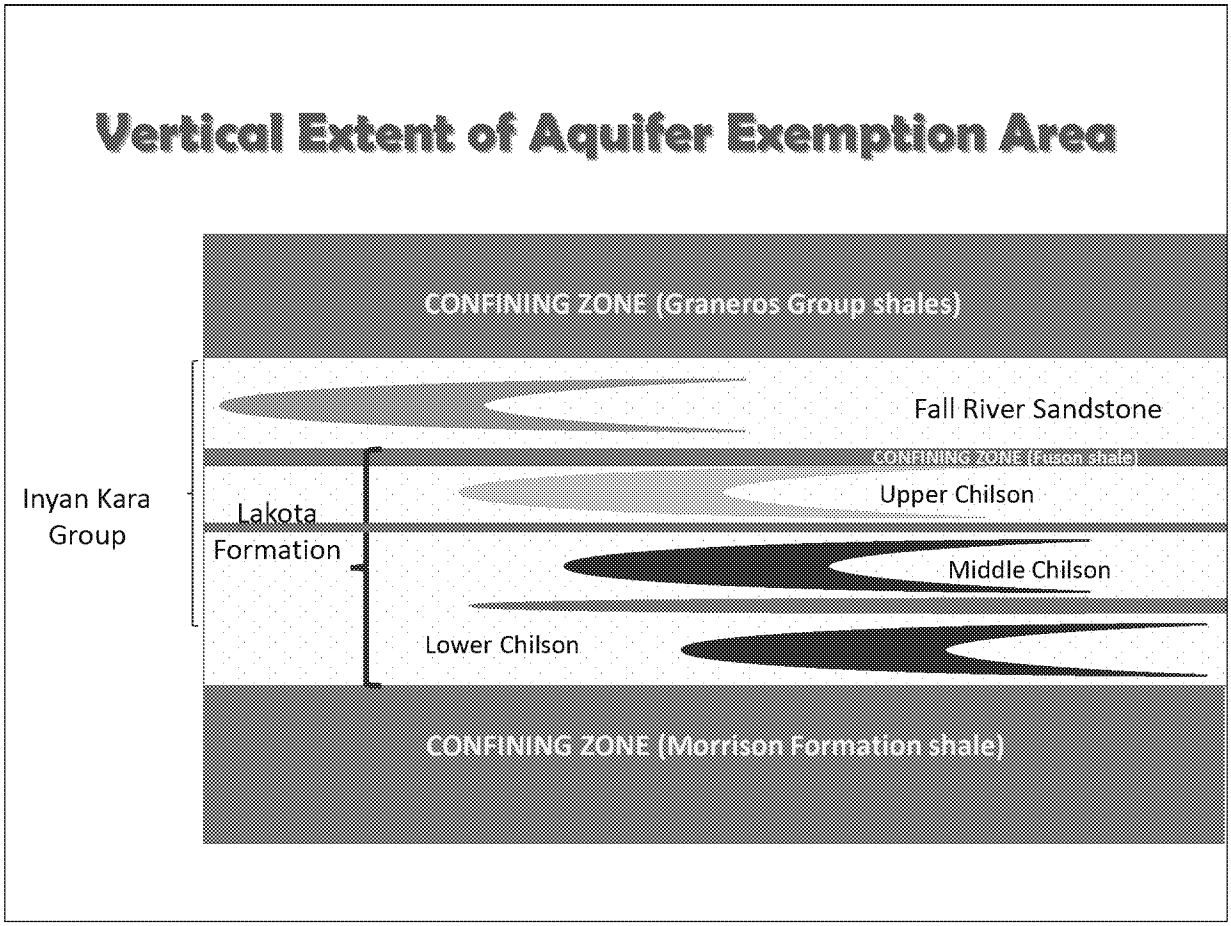

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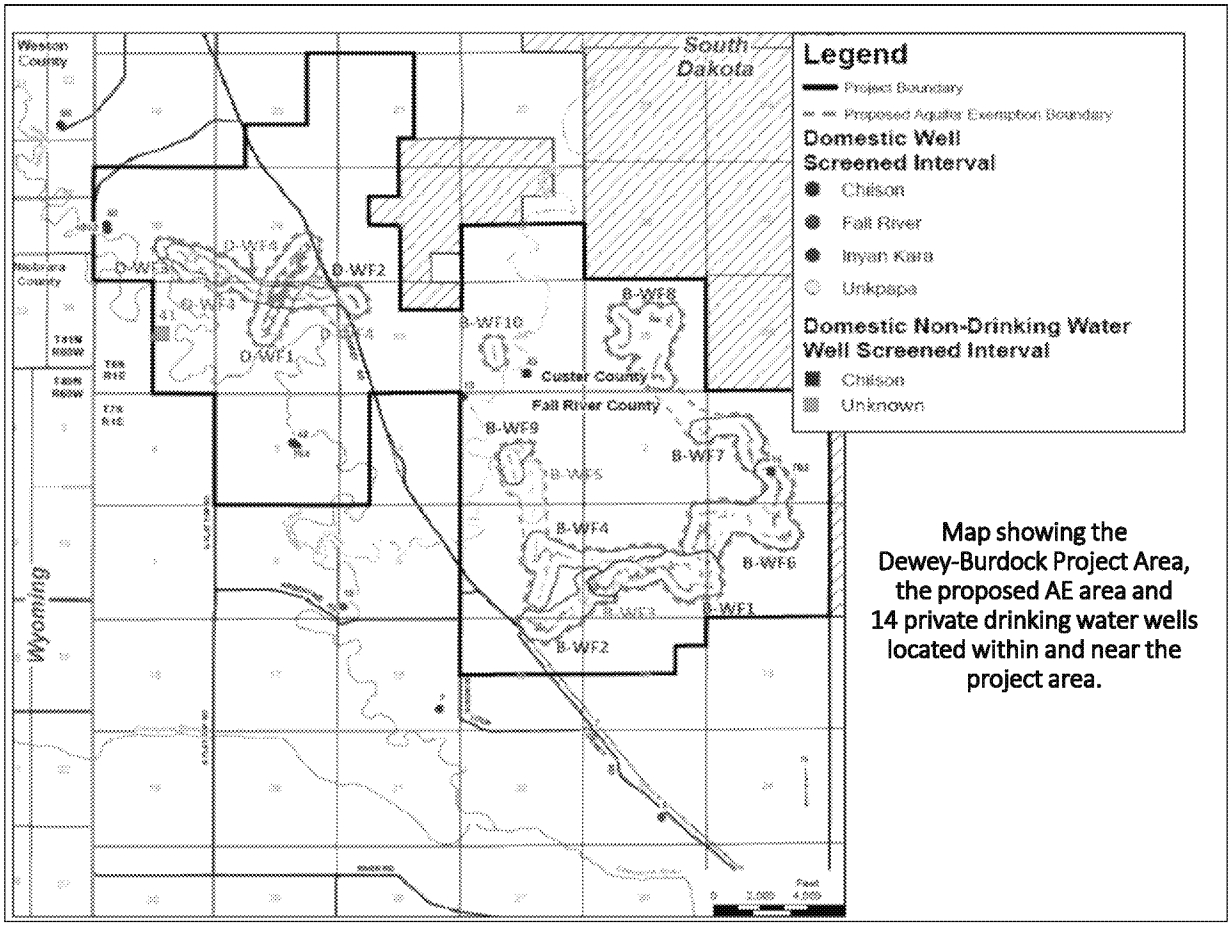
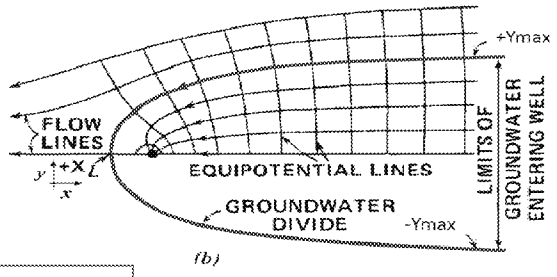


Map showing the Dewey-Burdock Project Area, the proposed AE area and 14 private drinking water wells located within and near the project area.

Private Drinking Water Well Capture Zone Analysis

Two different equations were used for the CZA:

1) the first equation calculates the upgradient extent of the capture zone; and
2) the section equation calculates the maximum width of the capture zone.



(b)

$$-\frac{Y}{X} = \tan\left(\frac{2\pi Kbi}{Q}Y\right)$$

UNIFORM-FLOW EQUATION

$$X_L = -\frac{Q}{2\pi Kbi}$$

DISTANCE TO DOWN-GRADIENT NULL POINT

$$Y_{max} = \pm\frac{Q}{2Kbi}$$

BOUNDARY LIMIT

LEGEND:

- Pumping Well
- Zone of Contribution

Where:
Q = Well Pumping Rate
K = Hydraulic Conductivity
b = Saturated Thickness
i = Hydraulic Gradient
π = 3.1416

} Transmissivity T=Kb

Private Drinking Water Well Capture Zone Analysis

$$t_x = n/Ki\,[r_x - (Q/2\pi Kbi)\ln\{1 + (2\pi Kbi/Q)r_x\}] \quad (4\text{-}7)$$

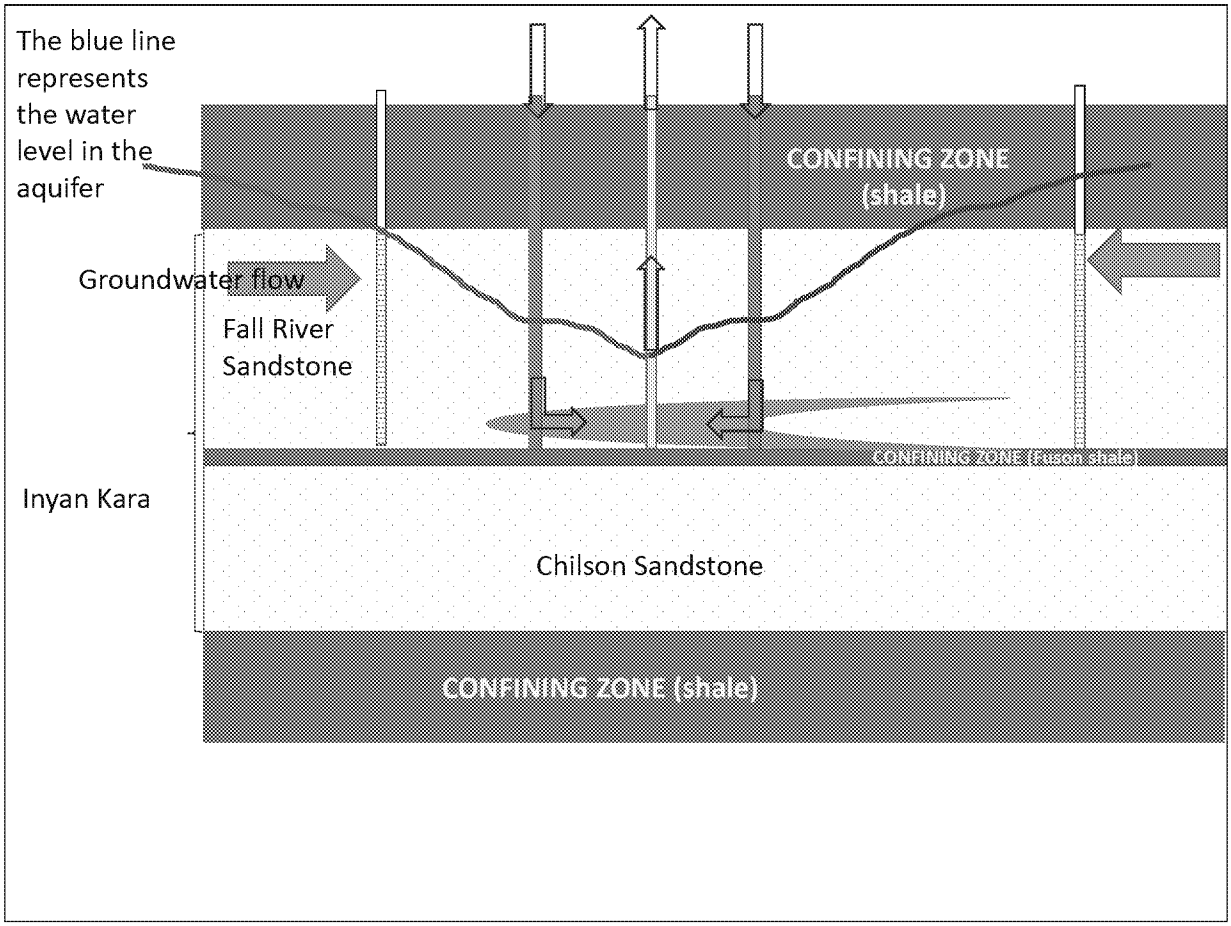
where
t_x = travel time from point x to a pumping well
n = porosity
r_x = distance over which ground water travels in T_x,
r_x is positive (+) if the point is upgradient, and
negative (–) is downgradient
Q = discharge
K = hydraulic conductivity
b = aquifer thickness
I = hydraulic gradient

T=Kb so I used Transmissivity

- From EPA's Handbook on Ground Water and Wellhead Protection
- Based on the Uniform Flow Equation
- Calculates the upgradient extent of a "zone of contribution" (ZOC) surrounding a pumping well.
- When there is a slope in the aquifer potentiometric surface the ZOC is asymmetric, extending farther upgradient than downgradient.
- The ZOC is considered to be the capture zone for the pumping well.

UIC Regulations

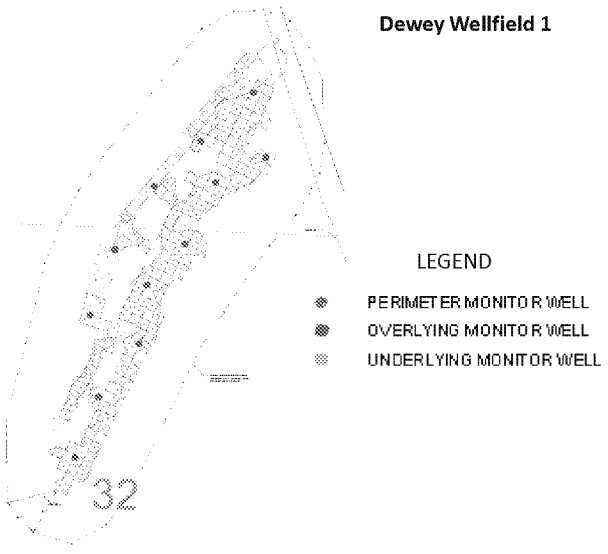
- UIC regulations require the permittee to conduct considerable testing to provide EPA hydrogeological and other data before any injection wells are authorized to operate.
- The data must demonstrate vertical confinement to prevent movement of fluids out of the injection zone so that no USDWs are contaminated.
- The data must also demonstrate that it is possible to contain injection zone fluids horizontally to prevent contaminant migration into USDWs.

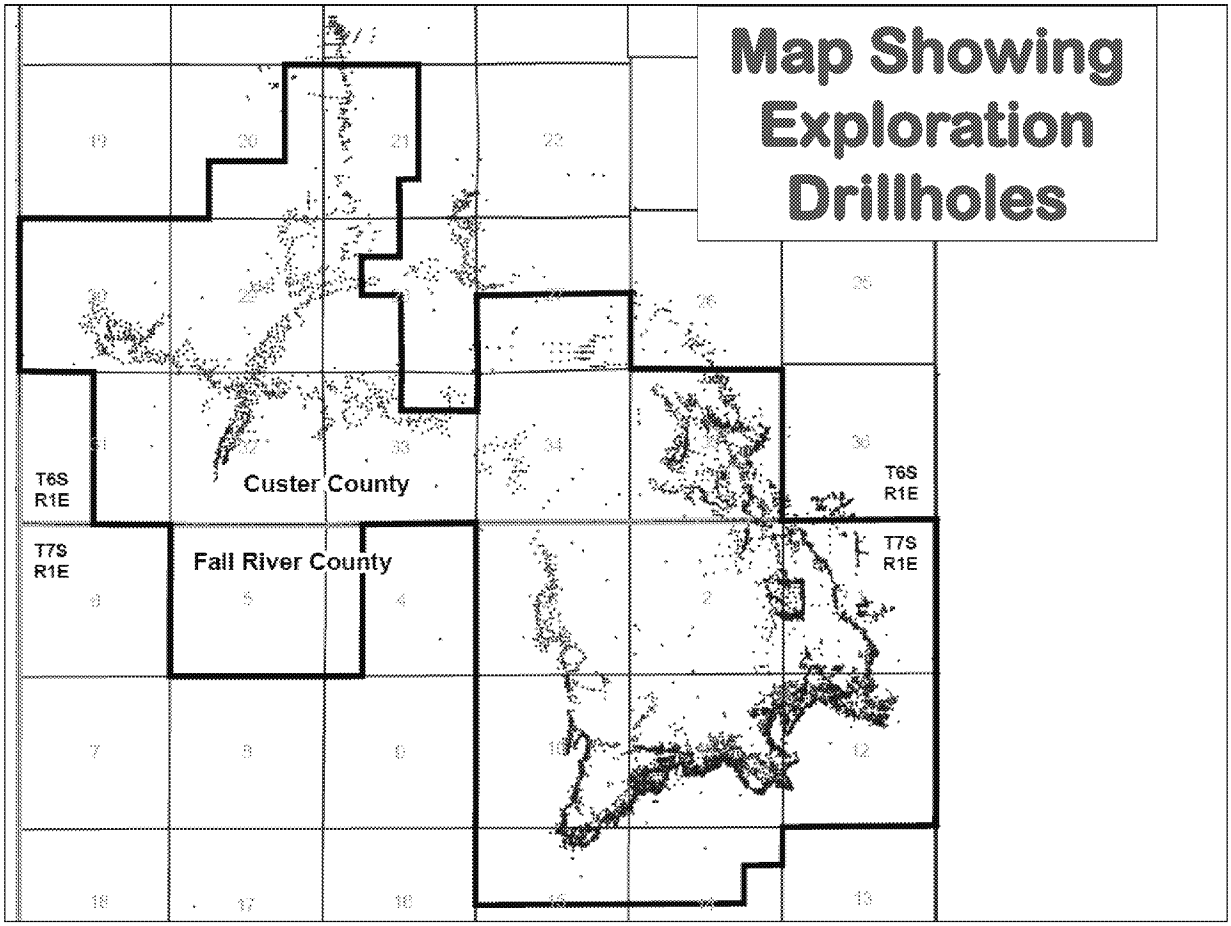


This slide shows the Inyan Kara aquifers that are proposed for the aquifer exemption (discussed later). The recovery wells pump more groundwater out of the aquifer than the injection wells pump back into it. That causes the water level in the aquifer to lower in and around the wellfield. This causes the groundwater flow direction to be toward the wellfield. That is how the horizontal control of the lixiviant if maintained. The monitoring wells (shown in white) are part of the perimeter monitoring well ring that is installed to monitor the groundwater level and groundwater quality outside the wellfield.

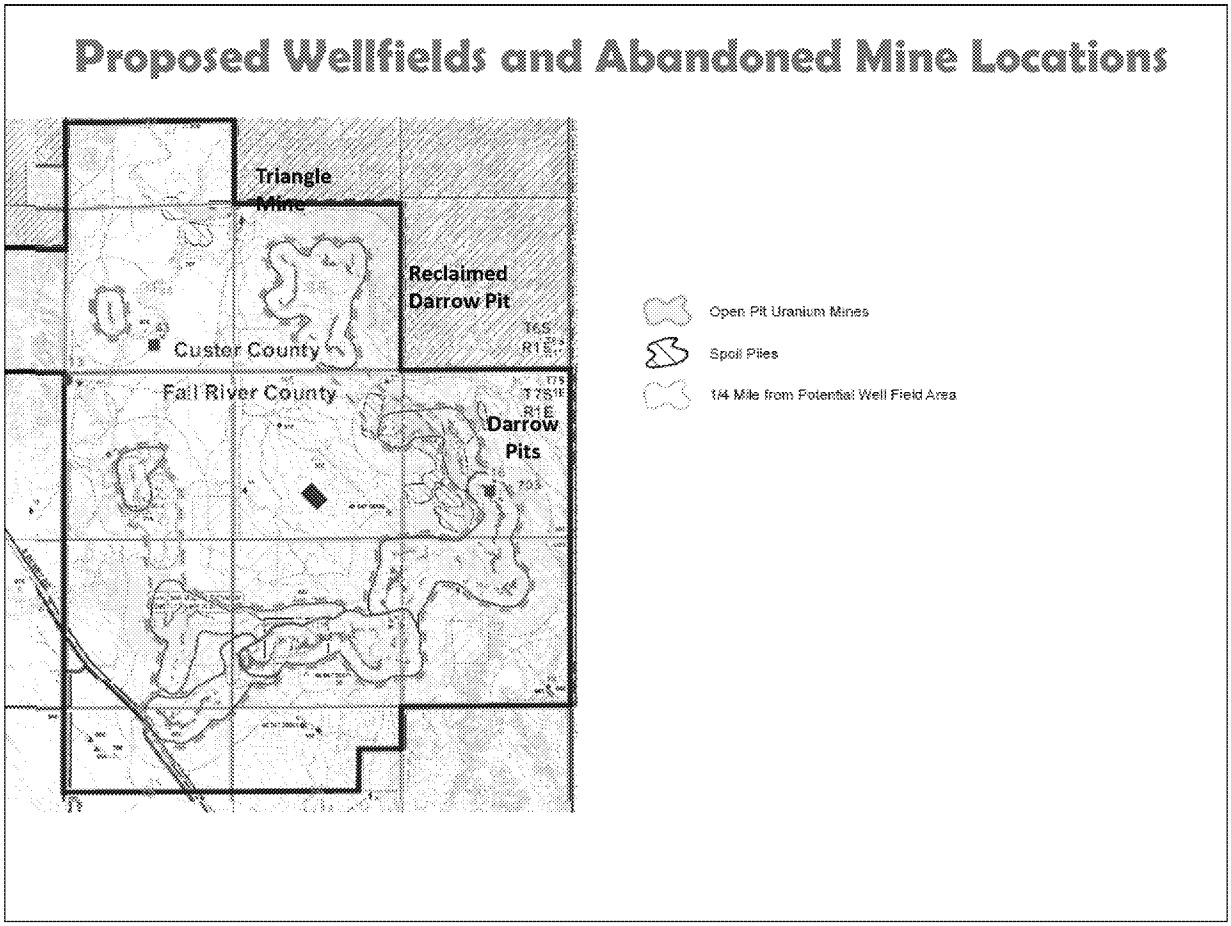
Ongoing monitoring in overlying and underlying monitoring wells (after ISR recovery process begins)

- All overlying hydrogeologic units will be monitored.
- Monitor wells completed in the first overlying hydrogeologic will have a density of at least one well per 4 acres of well field pattern area.
- Monitor wells completed in subsequent overlying hydrogeologic units will have a density of at least one well per 8 acres of well field pattern area.



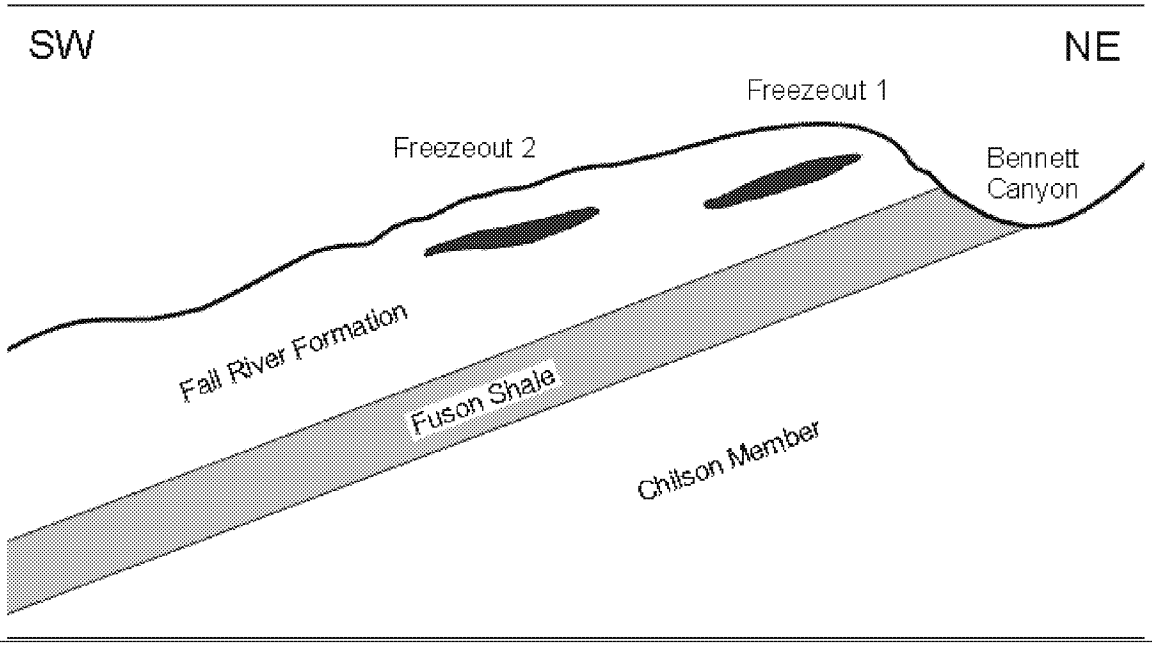


5932 drillholes 109 Powertech drilled

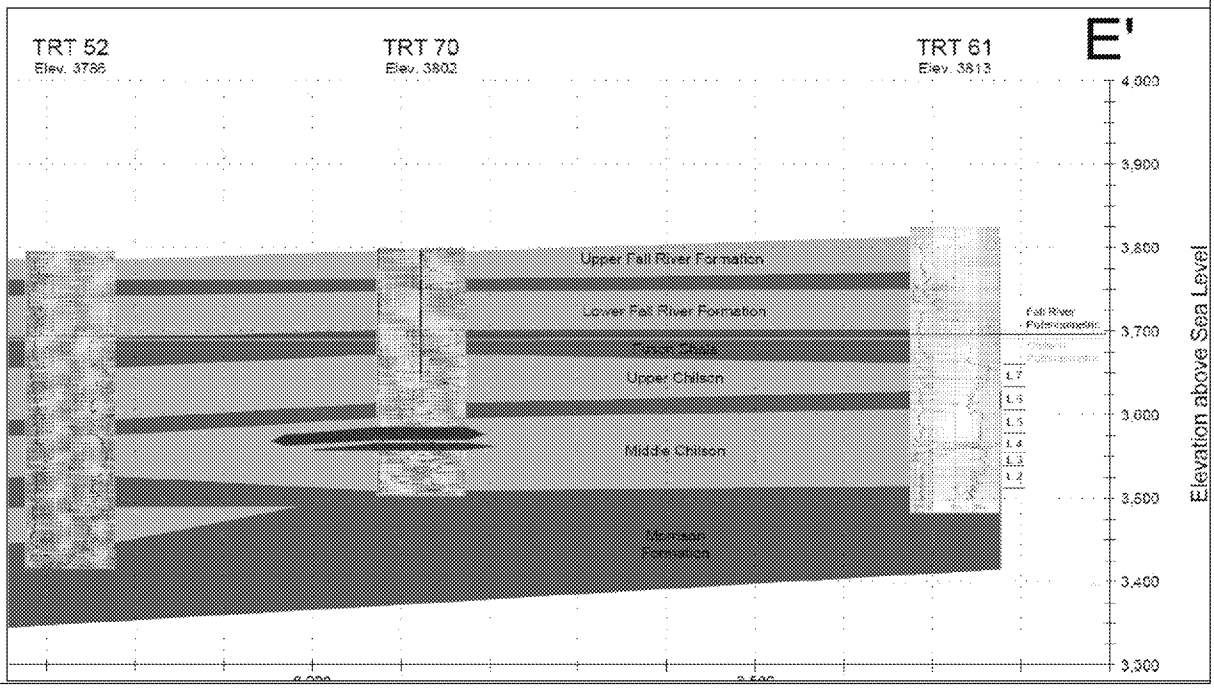


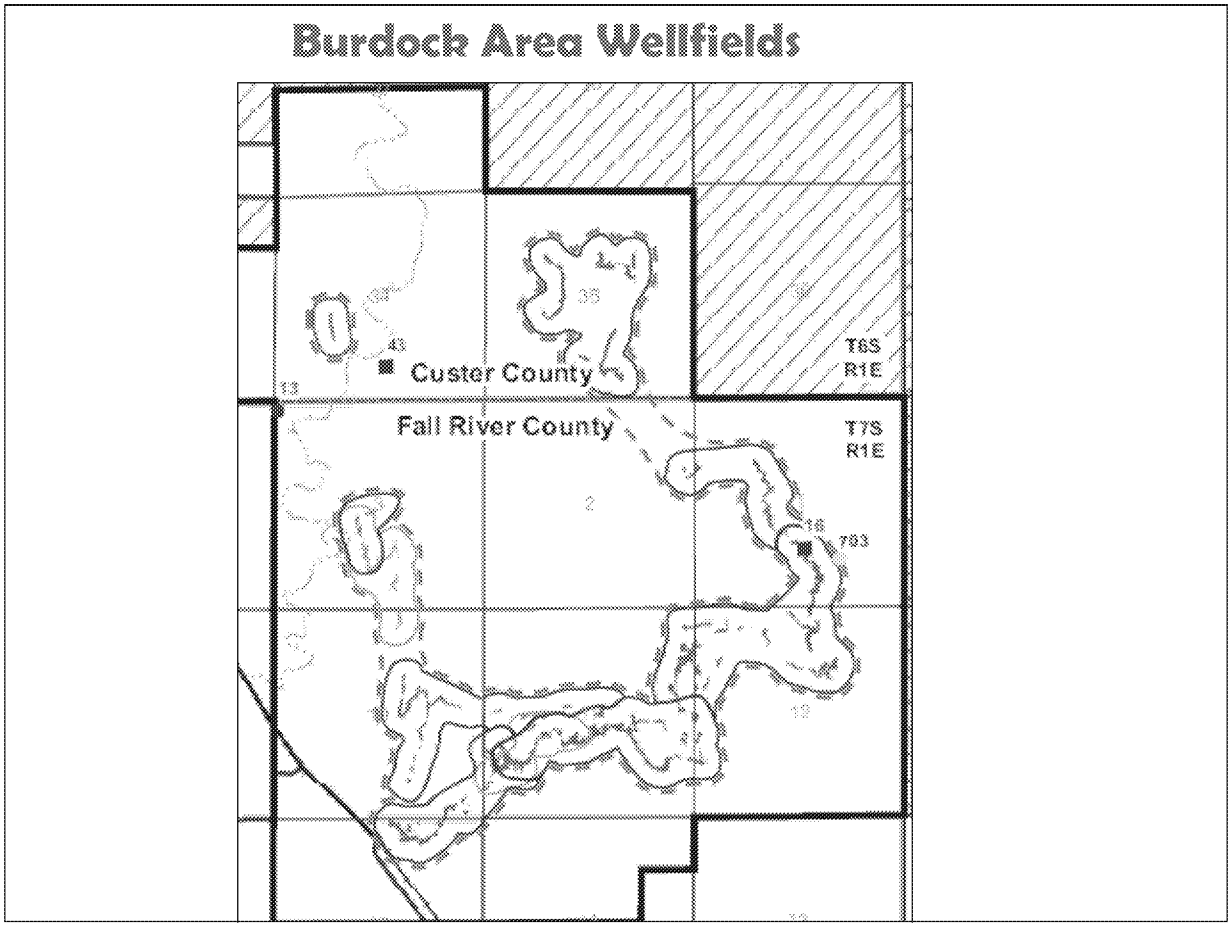
Check logs in cross-sections through WF 6, 7, 8 to see if the open pits are in the Upper or Lower Fall River

Uranium Ore Bodies Targeted by the Abandoned Uranium Open Pit and Underground Mines

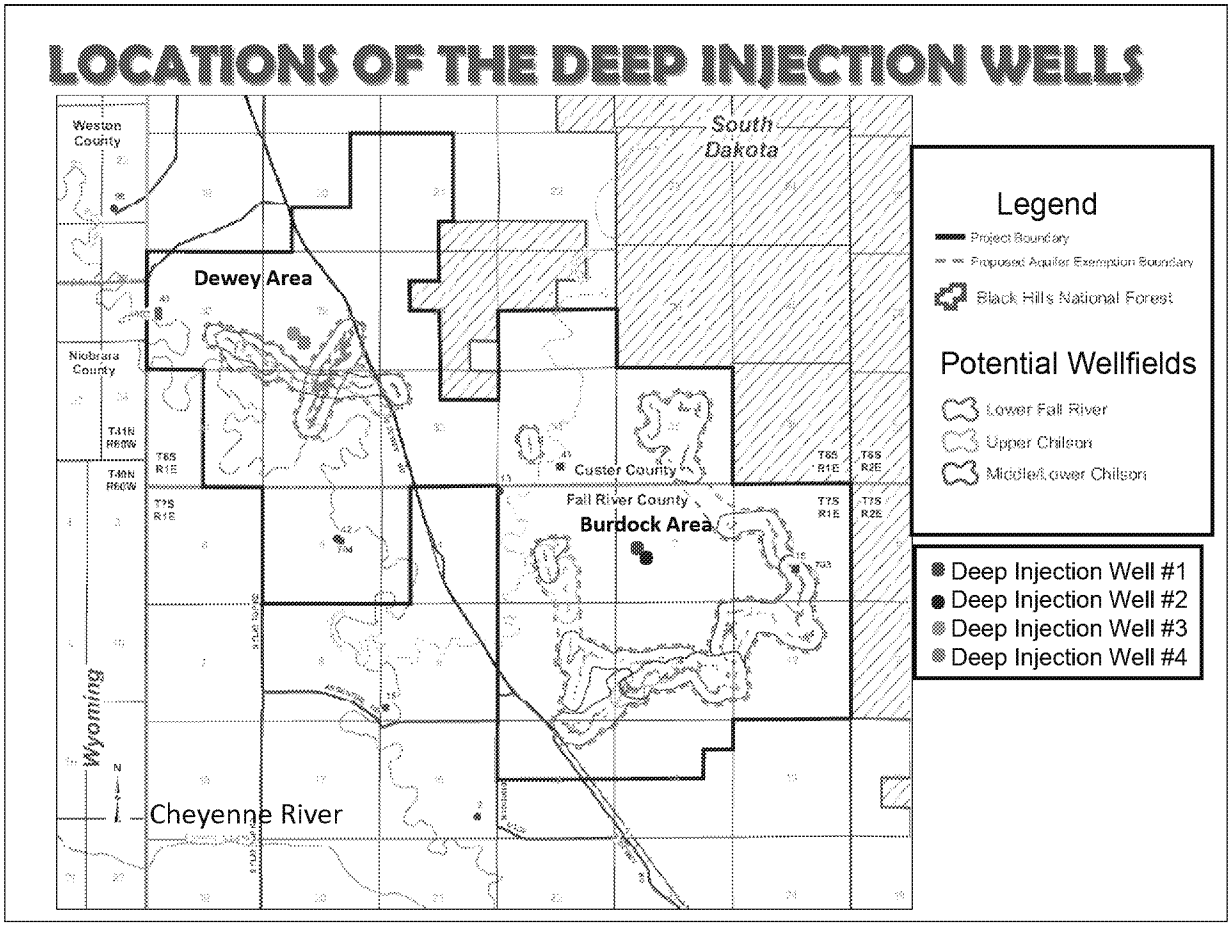


Chilson Potentiometric Surface & Targeted Ore Zones





Check logs in cross-sections through WF 6, 7, 8 to see if the open pits are in the Upper or Lower Fall River



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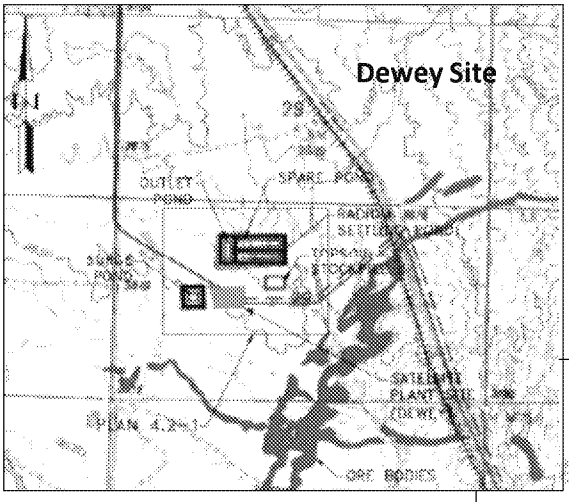
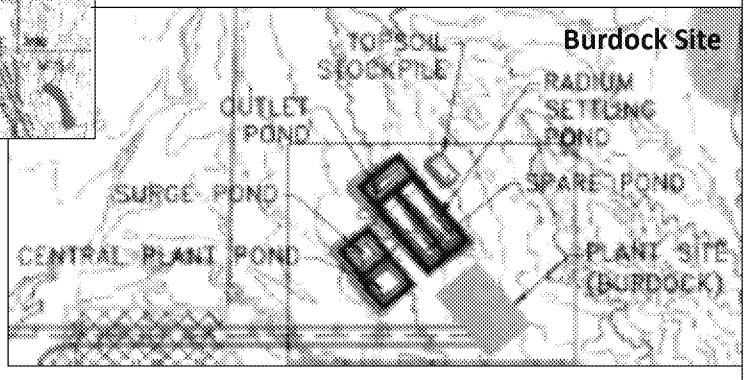
Treatment and Storage Ponds for Deep Well Injectate



Waste fluids from the uranium recovery process will the treated in the radium settling ponds. After radium removal, the treated water will be stored in the outlet ponds and surge ponds. There will also be a spare radium treatment pond for backup. After treatment, the water will flow to the deep injection wells.

The Burdock Area central plant pond will store brine from the reverse osmosis treatment process used during groundwater restoration before the brine is treated in the radium settling ponds.



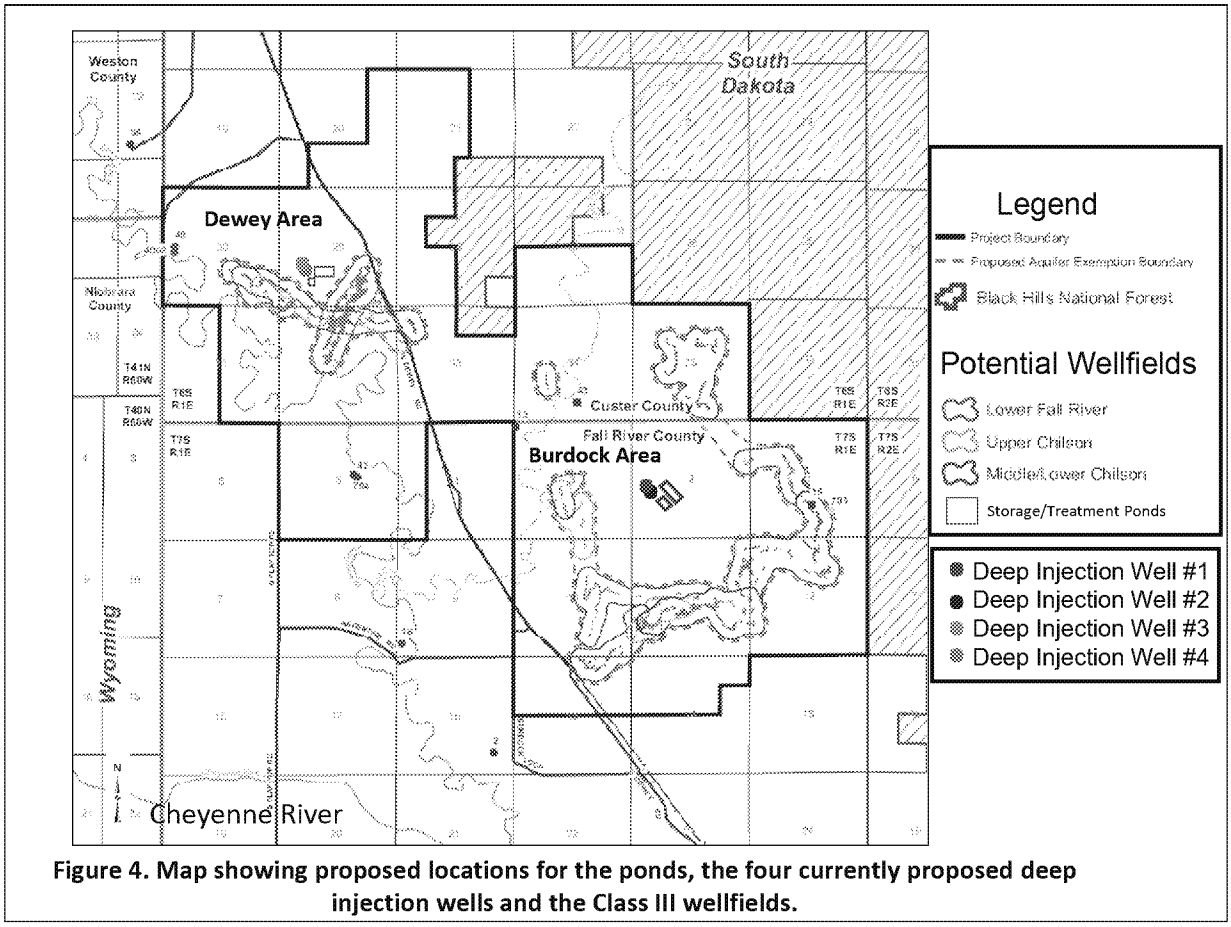


Figure 4. Map showing proposed locations for the ponds, the four currently proposed deep injection wells and the Class III wellfields.

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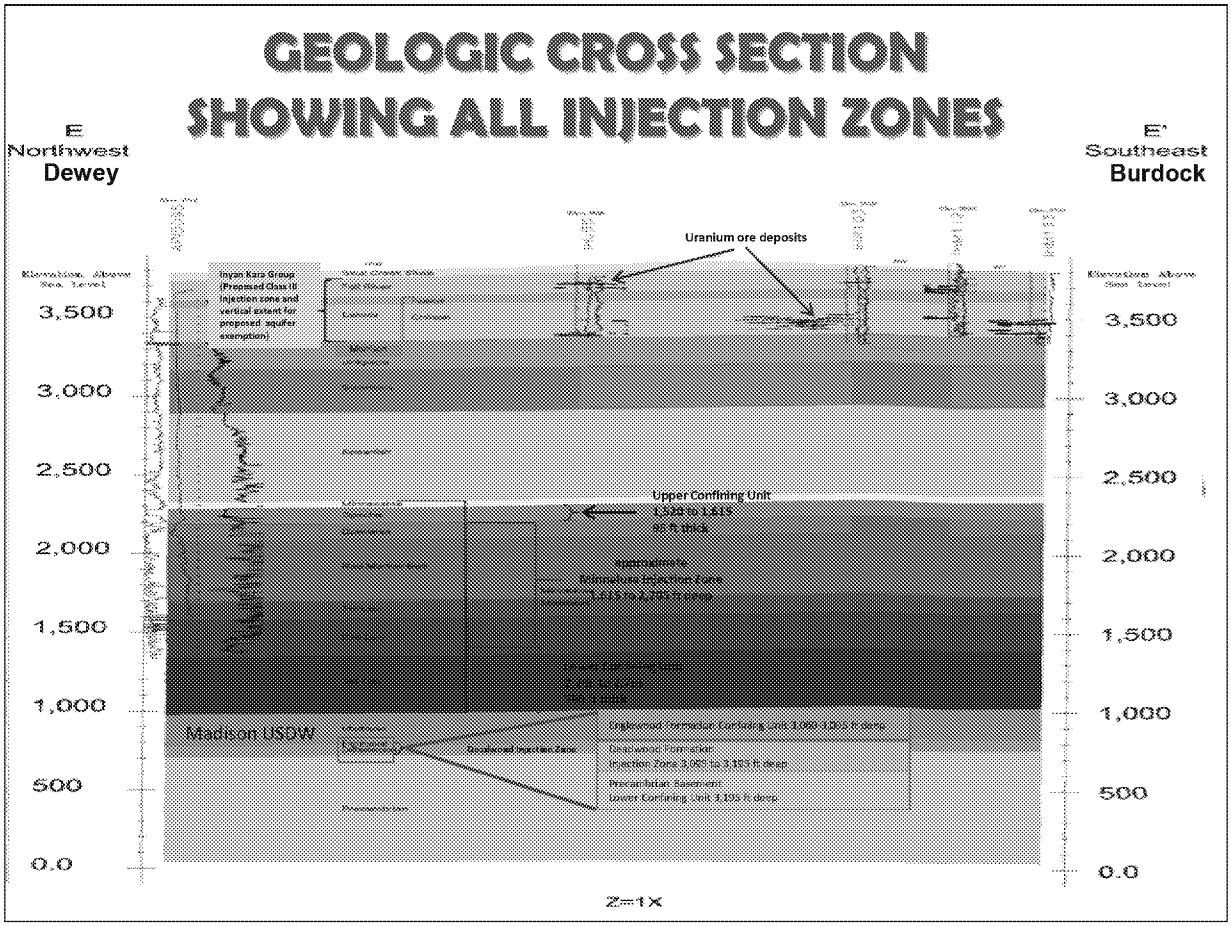
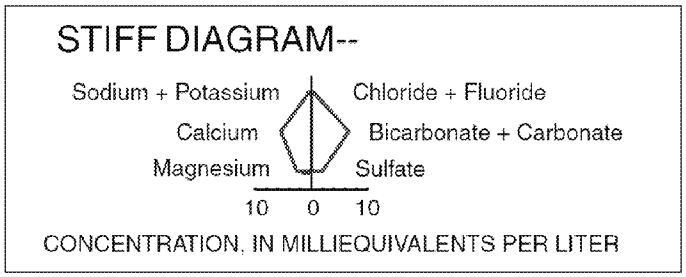
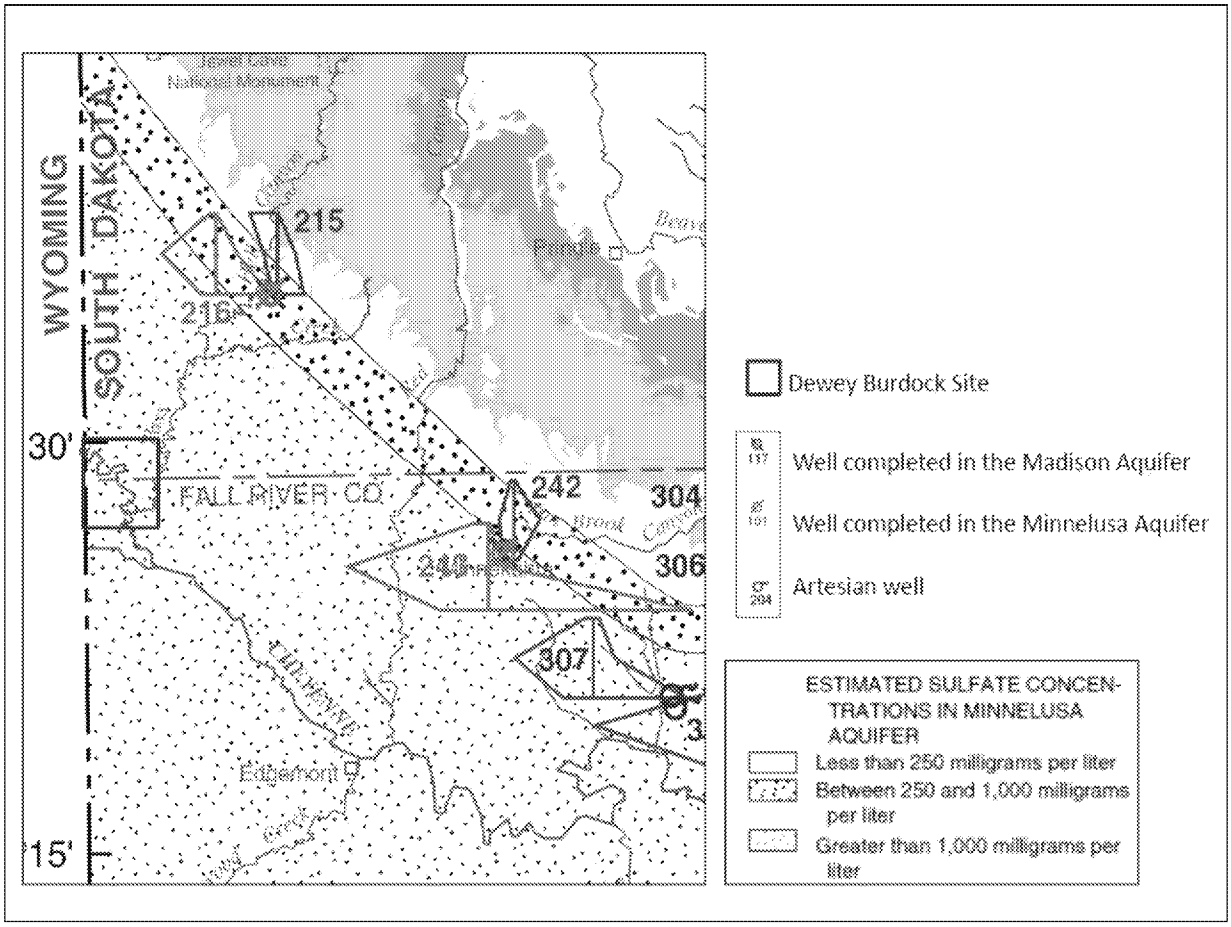


Figure 4. Stratigraphic Column at the Dewey Burdock Site Showing Proposed Injection Zones.
Enclosure to invitation letter

Sundance Formation	640	920	975	1255	Shale, sandstone, thin beds of limestone Basal sandstone
Spearfish Formation	920	1240	1255	1575	Red shales and siltstones with white gypsum beds and limestone layers.
Goose Egg Formation	1240	1480	1575	1815	Forells Lime Member (limestone) Glendo Shale Member(shale)
Minnekahta Limestone	1480	1520	1815	1855	Thin to medium-bedded fine-grained, purplish-gray laminated limestone
Opeche Shale	1520	1615	1855	1950	Red sandy shale, soft red sandstone and siltstone with gypsum and thin limestone layers. Gypsum locally near the base.
Minnelusa Formation					
Minnelusa Porosity Injection Zone	1615	2205	1950	2540	Porous eolian sandstones with interbedded shale and anhydrite (porosity zone)
Minnelusa Lower Confining Zone	2205	2765	2540	3100	Interbedded cemented sandstones with dolomite, shale and anhydrite[4]
Madison Formation	2765	3060	3100	3395	Limestone and dolomite Madison Aquifer occurs within the top 100 to 200 feet of the formation.[4]
Englewood Formation	3060	3095	3395	3430	Pink to buff limestone. Shale locally at base.
Deadwood Formation	3095	3195	3430	3530	Sandstone with beds of shale and limestone; basal conglomerate
Granite wash					Granitic pebbles formed by weathering of Precambrian basement locally present between the Deadwood Formation and the Precambrian basement
Precambrian basement	3195		3530		Undifferentiated metamorphic and igneous rocks


STIFF DIAGRAM--
Sodium + Potassium
Calcium
Magnesium
Chloride + Fluoride
Bicarbonate + Carbonate
Sulfate
10 0 10
CONCENTRATION, IN MILLIEQUIVALENTS PER LITER


WYOMING
SOUTH DAKOTA
30'
15'
FALL RIVER CO.
215
216
242
304
306
307
Edgemont
Dewey Burdock Site
Well completed in the Madison Aquifer
Well completed in the Minnelusa Aquifer
Artesian well
ESTIMATED SULFATE CONCENTRATIONS IN MINNELUSA AQUIFER
Less than 250 milligrams per liter
Between 250 and 1,000 milligrams per liter
Greater than 1,000 milligrams per liter

UIC Permitting Process

- After issuance of any draft permit and aquifer exemption decisions, there will be a 60 day public review and comment period.

- Other reviews required in UIC permitting process:
  - *Endangered Species Act,*
  - *National Historic Preservation Act 106 consultation,*
  - *Environmental Justice Analysis,*
  - *Cumulative effects of construction and operation of injection wells.*

- Ex. 5 Deliberative Process (DP)

National Historic Preservation Act

EPA's plans for addressing NHPA obligations:

- Consider the effects of the whole undertaking on historic properties, not just EPA-regulated activities.
- Consult with tribes (and others) during our review.
- Tribes possess special expertise in assessing eligibility of historic properties that possess religious and cultural significance.
- Seek Tribal input on identification of traditional cultural properties, determination of adverse affects and ways to mitigate the adverse affects.

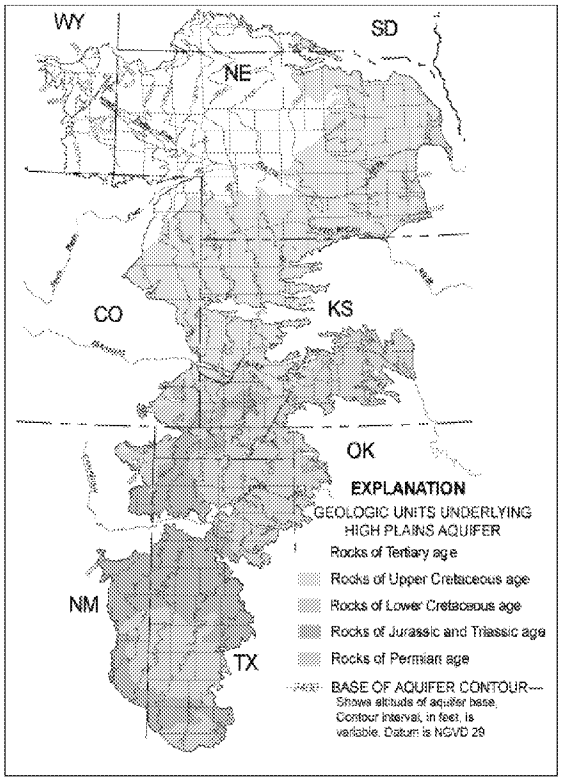
EPA has the option of designating NRC as the lead for this process, or of conducting the review ourselves.

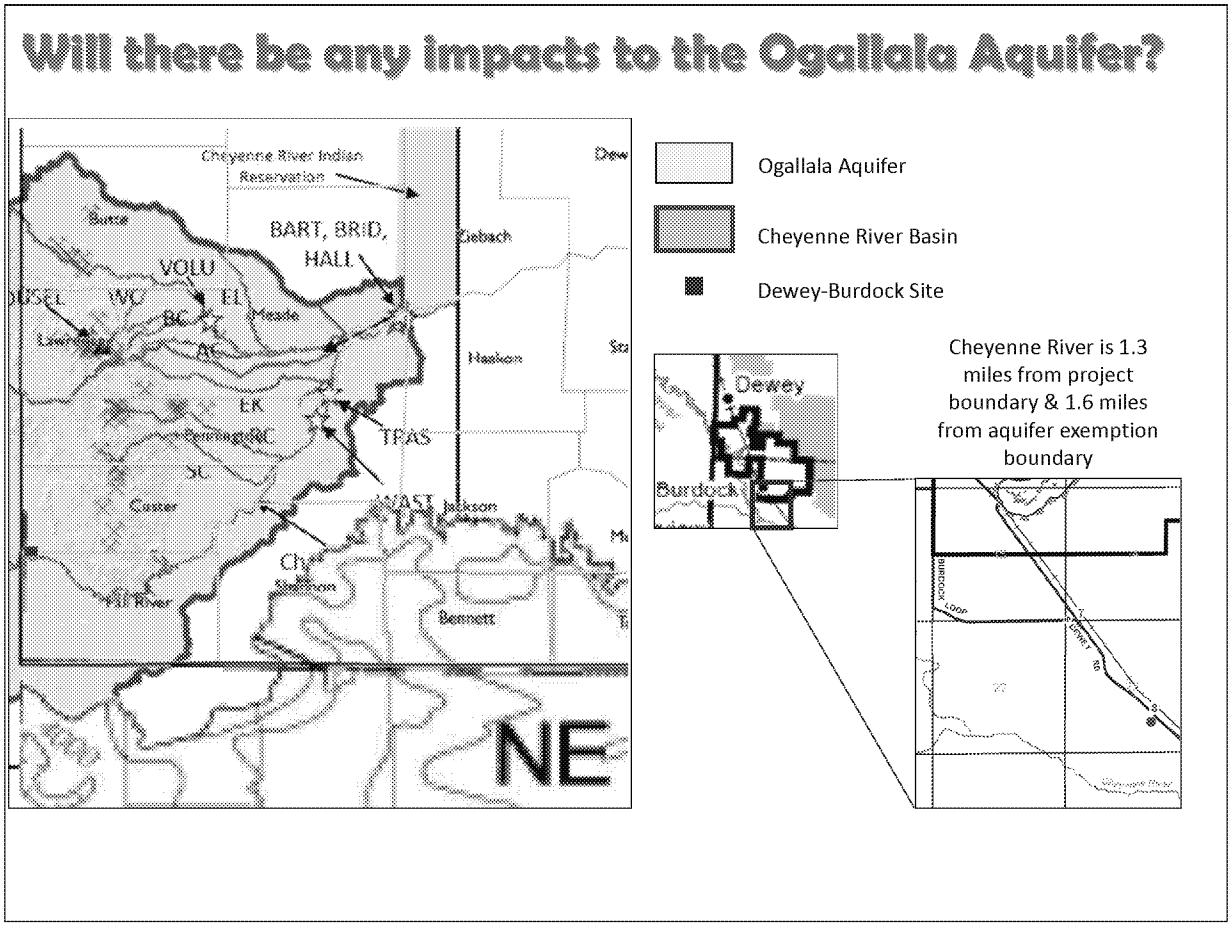
- The EPA is reviewing the historic properties information developed in the NRC process.
- This information is available to the public at http://adams.nrc.gov/ehd.

Issues Identified through Informal Consultation so far . . .

- Will there be any impacts to the Ogallala Aquifer?
- What are the impacts to places where medicinal or ceremonial plants will be gathered?
- Impacts to groundwater
- Impacts to surface water

Extent of the Ogallala Aquifer?





Notes from Standing Rock meeting: This just accounts for surface water. We need to look a subsurface/groundwater routes and impacts.

UIC Regulations

- UIC regulations require protection of USDWs around the AE area through extensive monitoring.
- UIC regulations require that no ISR process contaminants cross the aquifer exemption boundary during or after ISR operations.

UIC Regulations

- UIC regulations authorize enforcement action when UIC regulations and/or permit conditions are violated.
- Enforcement actions can include requirements for groundwater remediation activities if appropriate.